DOCUMENT RESUME

ED 072 497 CS 500 145

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TITLE An Experimental Comparison of Certain Cueing Systems in Group Problem-Solving.
PUB DATE Apr 72
NOTE 20p.; Paper presented at the Annual Meeting of the International Communication Assn. (Atlanta, April 1972)

EDRS PRICE MF-$0.65 HC-$3.29
DESCRIPTORS Behavior; Classification; *Cognitive Processes; *Communication (Thought Transfer); *Concept Formation; Decision Making; *Intellectualization; *Problem Solving; Recall (Psychological); Response Mode
IDENTIFIERS *Cueing System

ABSTRACT

This study investigated several questions generated by cueing system research. The cueing system is perceived as a means of directing our categorizing behaviors in the processing and recall of information. Experiments involved a comparison of categorical cueing systems on a given task in relation to two control areas: (1) subjects using a free recall format and (2) subjects given eighteen random words. The experimenter sought to determine if there is any difference in the viability of various cueing systems and if a random set of cues facilitate idea generation as well as a more fully developed system. He used a four level, one-dimensional analysis of variance: Wilson's and Arnold's attributes and relationships; Kant's categories of understanding; a randomized word list on the problem area; and control groups operating under the auspices of free recall. (Author/LG)

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ED 072497

AN EXPERIMENTAL COMPARISON OF CERTAIN CUEING SYSTEMS IN GROUP PROBLEM-SOLVING

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International Communication Association
Atlanta, Georgia
April 19-22, 1972

CS 500 145

The notion of the desirability of the generating of alternate responses to a given stimulus is one which has been held from the time of Aristotle to today's human scientist. Human behavioral theory, as it has developed out of such related disciplines as psychology, computer science, mathematics and communication, generally contends that intrinsic in man is a categorizing behavior which filters, sorts, and organizes knowledge. The answer to how many processes his information has been theorized and in some cases experimented upon from Aristotle through George Herbert Mead, to our most contemporary scholars. Input has been controlled, output has been measured and yet the question largely remains a mystery. While the answer may eventually come from exploration into the neurological networks of the human brain, this research proposes another approach. If, as researchers have concluded, man does filter, sort, and organize his knowledge into category systems, what effect would there be if a particular category system was imposed upon him? Would he generate more or fewer options to a stimulus situation? Would an imposed category system interfere with his own propensity to categorize and structure? Would there be a difference in the quality of options generated? Would there be a difference in output if different category systems were utilized? While a multitude of additional questions could be brought forth, this research seeks to provide some indication as to what the answers to these questions might be.

J. Ruesch[1] has suggested that there might be two independent thought systems: one which relates thought codification in artistic pursuits

(analogic), and the other concerned with scientific, mathematical and philosophical activities (digital). Van den Bogaerde[2] has stated that perhaps idea classification also has such basic levels. Such notions as these introduce the possibility that rather than there being one superordinate, universal, category system, as some have suggested, that category systems are linked in some way to the human organism's organizing behavior and the concept area with which he is concerned.

The concept of "categories" and "categorical systems," goes back at least as far as the writings of Aristotle, although the Platonic influence is clearly discernible. In the Aristotelian Categories one finds if not the first then certainly the first systematic attempt to construct a theory of categories. While there is no evidence to indicate that the categories of substance, quantity, quality, relation, place, time, position, state, action and affection were exhaustive, a position generally held by Medieval philosophers, there is little doubt but that this system was the most influential until the late 18th Century when Kant introduced his classification system which he did claim was exhaustive.

Little theoretical generation on the concept of categorization was accepted into the intellectual world between the time of Aristotle and the 18th Century skepticism of Hume. Perhaps one of the first to take opposition to the "thought of the time" was Immanuel Kant. He advanced the view that the world of phenomenon enjoys existence only insofar as we ourselves "participate in its construction."[3]

Kant believed that truth could be reached by an examination of a deeper channel of intelligence he described as categories of understanding.

This "apriori" element of structuring signifies that a conceptual framework is prior to the experiencing of the fact which reify events on a space-time continuity. Kant maintained that the principal of association would be inoperable were it not that events are impressible in familiar categories of experience; were it not that prior dispositions order events in the associative complexes that we do in fact understand.[4]

Human information processing involves the perception and subsequent organization of various forms of information to be used to make decisions and solve problems. Kant's categories of understanding represent the apriori conceptual structure of decision making and, as part of this experimental study, will, in itslef, serve as a cueing system which has as its end product the generation of quality solutions to a present day problem.

While the notion that humans have a propensity to categorize any array of stimuli may have its origins in ancient philosophy, this position has been more fully developed by such theorists as Bruner, Goodnow and Austin,[5] and by such empiricists as Mandler and Pearlstone.[6] A promising means of directing our categorizing behavior to improve man's intrinsic ability to process and recall information is referred to as a "cueing system" based upon a conceptual scheme. This component is described by Gross as ". . . one or more sets of categories or two or more variables that stand in ordinal, classificatory, or functional relationship to each other."[7]

The use of cueing systems in research dealing with information retrieval has been carried out by such researchers as Tulving and

Pearlstone,[8] Bousfeld, Steward and Cowan,[9] Mandler and Pearlstone,[10] Swets,[11] and Rubinoff and Stone,[12] to mention but a few.

Research most closely related to this study, however, has generated two major conclusions: (1) a cueing system aids in identifying, itemizing, organizing, and recognizing areas of concern. (2) The use of a topical (cue) system during idea generating leads to the discovery of more ideas than conventional idea generating strategies.

With regards to the first point, a "superordinate term" is considered by Borden and Nelson to be a neutral classifier (cue) for conceptual processes.[13] The use of cues for inferring categorical identity of a perceived object or problem area, has been treated by Bruner, Goodnow and Austin who felt that on the basis of certain defining or criterial attributes in the input--which they refer to as cues--there is a definite selective placing of the input in one category of identity rather than in another.[14] Categorization by means of cues was likened to placing an object, problem, or event into a universe by giving it identity as a subset of that universe.

That systems may combine to form additional systems is indicated in some of the work of Underwood.[15] In his studies concerning classification systems, he found that items were generated as members of a category because the elements of a category shared attribute and relational characteristics with each other and with the categorical cue.

The universality of certain superordinate terms and thus their generalizability to all subject matter, while suspect to the authors, nevertheless has been posited by several scholars. Hebb[16] in his work felt that by learning appropriate categories and categorical systems, one could learn the relations that exist between the properties of objects

and events that we encounter and in turn to predict and check what goes with what. Nelson[17] investigated the notion that dimensions of attributional and relational axes are identifiable and found that language meaning, conceptual activity, rhetorical arguments, and philosophical inquiry cluster according to categories, and the superordinates of these categories are identifiable.

Loeb's findings indicate that two implied sources of individual differences in recall determine the progress by means of the grouping or classification of items: (1) the number of units of information subjects used, and (2) the number of items per unit a subject can retrieve from storage. He contended that items grouped together would be recalled better if evoked by a common cue or by each other.[18]

Finally, Nelson placed this entire area into perspective when he stated that the use of a topical system directs the mind to places or dimensions where items related to a concept may be stored and classified. A topical system thereby assists the recall of the total universe of information an individual has associated with a given concept.[19]

Superordinate terms are neutral terms which, when applied to a concept, aid in generating information relative to that concept. Bousfield and Sedwick investigated the characteristics of superordinate terms and the characteristics of the associative responses and interpreted their findings as indicating that clustering was a consequence of organized thinking and recall.[20]

Sherif and Sherif indicated in their research that there was good evidence to suggest that respondents do have a "tendency" to structure and pattern that which they experience, and external structuring stimuli

such as a cueing system, exert a marked influence on the internal processing of experience.[21]

Under actual experimental conditions, cueing systems proved to aid recall of information relative to a concept when aided by neutral cues which served to generate information retrieval. Nelson in his work hypothesized that topoi serve as semantic representation for relevant discrete categories of information within a person's memory system. His experiment with topoi generated by Wilson and Arnold employed as a cueing system indicated that superordinate terms in the form of topoi were effective conceptual stimuli for highly meaningful and less meaningful issues. This supported the claim that topoi can act as important aspects of the invention process.[22]

Dominic Infante in a related study to Nelsons', constructed a topical system based on a construct developed by Lee S. Hultzen. He varied the cueing system, the task, and the form of recall and found that subjects still discovered more when cued by topoi in the generation of arguments as well as for the generation of information which Nelson tested.[23] The observation made by Nelson that subjects discover more information when cued by topoi was further affirmed.

Nelson and Petelle[24] extended the research on cueing systems by employing cues as a stimulus to group problem solving. They used the cueing system developed by Wilson and Arnold and found that small groups using a topical system while problem-solving generated solutions for a major social problem, which, when compared to the solutions generated by small groups of subjects not using a topical system were ranked as being more thorough and workable by both the subjects who used the topical cueing system and the subjects who did not.

The previously cited research readily allows one to generate a number of questions: (1) Is there any difference in the viability of one cueing system over another? In other words, is it possible that a concept area or an individual's unique categorizing behavior dictates his use of a cueing system? (2) If, as some research has suggested, an individual has a propensity to generate his own cueing system, will this be superior for him than one imposed upon him? If one does generate his own system, will this "interfere" with an imposed system? (3) Will a random act of cues arranged into a cueing system provide as viable a cueing system as a more theoretically developed system? It is to questions such as these, that this research addresses itself. Research in the past have made use of categorical systems only as an isolate in opposition to free recall and brain storming. No research has been completed or reported which compare categorical systems in order to ascertain if one system such as the Wilson and Arnold system, generates and organizes information "better" than other recognized cueing systems. Specifically, then, this study will attempt to: (1) Compare categorical cueing system on a task, and to (2) Compare the system to two control areas: subjects using a free recall format and to subjects given eighteen random words related to the task area.

PROCEDURES

The following experimental design outlines a study presently under way at the University of Nebraska:

The hypotheses to be tested are the following:

1. Will the Wilson and Arnold cueing system generate more responses and quality solutions than will Kant's categories of understanding or the randomized word list or the free recall group?

2. Will Kant's categories of understanding generate more responses and quality solutions than will the randomized word list or the free recall group?

3. Will the randomized word list generate more responses and quality solutions than the free recall group?

All comparisons will be made at the .05 level of significance.

The design will be a one-dimensional analysis of variance with the dimension containing four levels: Wilson & Arnold's categorical cueing system; Kant's categories of understanding; a randomized word list on the concept area; and control groups operating under the auspices of free recall.

The Wilson & Arnold system of attributes and relationships has been used extensively by Nelson in his research on recall. Kant's categories of understanding were developed by Buchholz into a cueing system in a prior unpublished paper. Kant's system will serve to ascertain if differences exist in cueing systems. A third cueing system comprised of randomized words will serve to reveal if any symbolic cue will serve to generate information and that the cue does not have to qualify as a "superordinate." The word list was compiled by a group of subjects who generated words on the problem area of pollution. The responses were randomized and a list of eighteen chosen to serve as a cueing system.

The dependent variables are number of responses generated and the number and quality of solutions. The "quality" will be determined by criteria established prior to the experiment to be assessed by qualified judges.

Subjects. Subjects will be 160 students enrolled in sections of the basic speech course at the University of Nebraska. They will be

randomly assigned to groups of five for the purpose of participating in a group problem-solving situation.

Instructions. Instructions and a practice session will be established prior to the actual experiment. They will be given background information concerning problem-solving discussion and will be reminded of the importance of thorough and workable solutions. They will be provided their respective cueing systems with instructions concerning their possible utility.

The experiment will take place in three timed periods. The first period will serve to orient the subjects to problem-solving and a practice session will take place. In the second period, the subjects will be asked to generate as many responses as possible to the concept area "pollution." In the third period, the subjects will be asked to take their responses to the concept area and generate from them as many solutions to the problem as they can in the time limit.

Note: In related pilot studies, task dimensions and levels of integrative complexity will serve as additional variables in order to maximize the potential utility of categorical systems.

RESULTS

Number of responses generated:

The results of the study with regard to the number of generated responses according to cueing systems are reported in Tables 1-4. As the one-way analysis of variance indicates in Table 1 (df = 3, 12; F = 2.41), there was no significant difference in the number of responses generated according to cueing system (W & A = Wilson and Arnold; K = Kant; FR = free recall; RW = random word list). Normally, an insignificant F would preclude further statistical analysis. This procedure was not followed, however, for three reasons. (1) A closer examination of the data indicated an unusually high amount of variance between the groups (W & A = 1368.91; K = 212.66; FR = 674.24; RW = 264.91). (2) An inspection of the difference in group means showed considerable discripancy between all of the cue groups and the free recall group (W & A = 103.25; K = 96.00; FR = 58.75; RW = 87.75). (3) Inasmuch as this study was considered to be just an exploratory study for further research in this area the researchers felt a certain amount of "statistical snoop" was warranted. Consequently, a T test was conducted between each of the cue groups and the free recall group. The results are reported in Tables 2-4. As indicated, significant differences did occur between the W & A and the FR group; between the K and the FR group; no signficant difference was found between the RW and the FR groups. Further statistical analysis revealed no significant differences between any of the cue groups (Tables not shown).

Number of solutions generated:

The results of the analysis of variance run on the number of solutions generated by all groups is reported in Table 5.

As the one-way analysis of variance indicates in Table 5, there were no significant differences found in the number of solutions generated according to cueing system (dF=3, 12; F=1.81). Again, as was the case with the number of response generations, normally one would stop any further statistical analysis at this point. Contrary to the procedures followed with the response generation, further statistical analysis was suspended. This was done because (1) the amount of variance while still high (W & A = 71.99; K = 102.91; FR = 57.66; RW = 48.66) in no way compared with the amount of variance found in the response generation. (2) the group means were much closer than was the case with the response generation means (W & A = 35.00; K = 38.25; FR = 27.50; RW = 35.00).

Interpretation of Results

The obtained results regarding the number of responses generated according to cueing system can probably be explained in the following fashion. Analysis of variance indicated no significant difference among the cueing systems and the free recall group. The most likely explanation of this can be attributed to the unusually high amount of variance among the groups along with the relatively low N. A difference in the instructions given the groups may account for much of the variance. The study was administered on two successive nights (Monday and Tuesday) with two of the W & A, K, FR and RW groups appearing on Monday night and the other two W & A, K, FR and RW groups appearing on Tuesday night. A major difference in instruction given the groups occurred with the Tuesday night groups. In attempting to determine if verbal motivation might yield a higher rate of productivity, the Tuesday night groups were impressed with the importance of their participation and encouraged to do as well as possible. A descriptive analysis of the number of responses generated between the Monday night groups and the Tuesday night groups revealed that the Tuesday night groups tended to generate far more responses. Another possible source of variance could have occurred as a result of different instructors administering the instruction (16 groups, 16 instructors). The significant differences which did occur between the W & A and FR groups and between the K and the FR groups further substantiate the viability of a cue system in facilitating response generation. A tentative conclusion to be drawn as a result of the no significant difference between the RW and the FR groups is that a cue system based upon some theoretical

basis is superior to random words. Further research, however, should be engaged in to test this proposition.

SOLUTIONS

As indicated previously the amount of variance among the number of solutions generated, while still high, was considerably less than for the response generations. In part, this might be explained by the difference in the number of solutions generated as opposed to the number of single item responses generated. As the total N for number of solutions was lowered when compared to the total N for number of responses, one might reasonably expect, at the same time, a lesser amount of variance for solutions generated than for responses generated. Another possible explanation for the lesser amount of variance in the solutions generated might be attributed to the fact that it is easier to generate single item responses to a concept area than it is to take those responses into consideration when formulating a policy kind of solution. Another potential explanation for this is that the solutions were generated during the second phase of the experiment. By this time, presumably, the subjects had become more familiar with the process of using a cueing system. Greater familiarity with the use of cueing systems might very well have resulted in lesser variability in subject response.

The lack of variability among the group means might be explained in the following fashion. First of all, on the basis of the interpretation of the results, there appeared to be a tendency on the part of the subjects when in the process of generating solutions to go back to the responses they employed as their primary cue for solution generation, rather than to go back to the original cues. One possible interpretation

of this might very well be that what the subjects were actually doing with regard to their responses was to utilize their responses as a kind of sub-cueing system. While a cursory inspection of the group means indicated no significant differences among them, it should be noted as it was with the case of the responses that each of the cueing systems resulted in a higher group means than did the free recall group. While it was apparent that there were no statistically significant differences among the group means, it was also just as obvious that the Wilson and Arnold system, the Kant system, and the random word order system resulted in a greater amount of solutions generated than did the free recall group. Again, this finding is consistent with other research regarding the viability of cueing systems in the production of solutions.

A quick examination of this paper will readily indicate to the reader that this has not been the cleanest of all possible studies. Although this was not the original intent of the researchers, circumstances beyond our control worked to affect such a situation. In the final analysis, however, this may not be as detrimental as one might expect. The primary purpose of this research was to open up some possible avenues for continued research. Very few questions in the area of cueing as it relates to problem solving behavior, either in individuals or in groups, has been explored. A number of other possibilities generated from this research has to do with the possible combining of various cueing systems into new cueing systems; the possibility of the responses generated to a cueing system as being formulated into a cueing system of their own; and the possibility of some cues which might be identified as attributes being a more viable cueing system than other cues normally identified as relationships. In any event, the future questions and hypotheses which may be formulated

from some of the unanswered questions resulting from this research may prove to be the most valuable contribution this particular proposal has made.

TABLE 1

One-way ANOVA Among Cueing Systems

	dF	MS_b	MS_w	F
W & A	3, 12	1523.22	630.18	2.41
K				
FR				
RW				

TABLE 2

Comparison of Group Means Between W & A & FR

	M	SD	T
W & A	103.25	36.99	
FR	58.75	25.96	2.41*

TABLE 3

Comparison of Group Means Between K & FR

	M	SD	T
Kant	96.00	14.58	
FR	58.75	25.96	2.01*

TABLE 4

Comparison of Group Means Between RW & FR

	M	SD	T
RW	87.75	16.27	
FR	58.75	25.96	1.03

*p= < .05; one-tailed test

Addendum

In addition to the conclusions reported in the findings, a few other considerations can be made. A questionnaire was administered to the subjects following the experiment. From the answers obtained, the following assessments were made:

a. Subjects felt the use of a cueing system aided in the generation of responses. The consensus was highest among the Wilson & Arnold subjects follwed by the Kant subjects and the lowest consensus of utility was the using the randomized words.

b. Subjects were in less agreement concerning the utility of cues for generating solutions.

c. Subjects indicated that they did not feel constrained by the cues imposed on them.

d. A majority of the subjects felt that certain cues fit the concept area better than others. (topic bound)

e. Subjects were asked to rank the importance of the cues and this indicated that subjects preferred attributional cues as opposed to relational cues. This brings up an area for studying a two phase cueing system, first employing cues of attributional quality for response generation and secondly, relational cues for solution generation. This parallels the psychological view of two system memory; a working memory which works with perception and a long term memory which acts to associate, assimilate and process upon rehearsal.

Such responses indicate numerous areas for further consideration.

FOOTNOTES

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